4.0 V&V STATUS AND USAGE HISTORY

4.1 V&V STATUS

4.1.1 Overview

EADSIM is a large and complex mission-level simulation that has received wide acceptance and use within DoD and has a large, active user base. There have been several notable efforts related to face validation, or expert review, of the simulation. These efforts include:

- Analytical Tool Box (ATB) Confidence Assessment of EADSIM Version 3.0 in August of 1993.
- AFOTEC survey of EADSIM V&V efforts and results published in draft form in December 1993 with the final report published in November 1994.
- Theater Missile Defense (TMD) COEA assessment of EADSIM version 4.02 in support of the COEA Phase 1 analysis effort.
- In addition, several respondents to the AFOTEC survey mentioned V&V related activities performed with their own organizations, but results were either not documented or are not releasable.

4.1.2 Available V&V Documentation

The available V&V documentation for EADSIM versions 3.0 through 4.02 is summarized in Table 4.1-1. The ATB and TMD COEA assessments are the best documented. The AFOTEC survey of users of versions 2.0 through 4.0 identified several potential sources of V&V results but none were examined due to the unavailability of the V&V documentation. Reasons for unavailability included (a) not releasable due to security classification of the V&V results and (b) not releasable because validation was still in process. The following paragraphs summarize each of these assessment efforts.

TABLE 4.1-1. EADSIM V&V Documentation.

V&V Performer & Dates	V&V Status Summary	Comments
Analytical Tool Box Level One Confidence Assessment (8/93)	Results were very favorable - Met or exceeded most guidelines	1 week assessment - limited execution of the model (Version 3.0)
AFOTEC V&V Survey Report (November 1994)	Version 3.0 primary focus - Mostly positive responses - Some users performed validation against test data but results were not reported (Classified Data)	Consisted mainly of responses to questionnaire (39 of 150 returned) and telephone follow-up. Good summary of EADSIM revisions 2.02 through 4.0.
TMD COEA M&S Panel On-site Assessment	TMD COEA-specific assessment - Favorable assessment	Draft report available and being reviewed by IVV&A Organization (SDC)
EADSIM IVV&A Contractor (Systems Development Corp. - Started 4/94)	V&V has consisted primarily of source code analysis, test witnessing, SCR assessment, development and CM process assessment, and user surveys.	SOW is broad enough to support extensive IVV&A tasking. However, FY96 LOE is about one person.
User V&V	No reports identified to-date	

4.1.2.1 ATB Assessment (August 1993)

The Ballistic Missile Defense Organization under the National Test Bed's Analytical Tool Box conducted a Face Validity Assessment on EADSlM Version 3.0 and drafted the EADSIM Face Validation Assessment Report dated 20 August 1993. The purpose of the 1-week face assessment was to evaluate EADSlM for recommendation and acceptance into the Analytical Tool Box. The ATB assessment was very well documented and is available as an internal BMDO report (document number not available-obtain from Dr. John Sessler at BMDO/AQM, Suite 1200, Crystal Square II, 1725 Jefferson Davis Highway, Arlington, VA 22202 (703) 413-0314).

The assessment addressed Ballistic Missile Defense Organization needs in the areas of operational effectiveness and resulted in the following summarized observations.

- Process Fidelity met guidelines but the Theater Missile Defense (TMD) treatments are not mature. EADSlM has appropriate overall process fidelity for a medium-fidelity model with the exception of the process areas of Tracking and Data Fusion, Resolution and Discrimination, and Resource Allocation.
- Equipment Realism met the established guidelines. EADSlM has appropriate overall realism in all areas of equipment. However, not all aspects of the BMDO standard threat tape are modeled.
- Bias (Lack of) met established guidelines. EADSlM has appropriate overall realism in all areas with the exception of the use of Ground Truth/Reliability of Equipment. Any medium fidelity model requires calibration which has not been done for EADSlM.
- Flexibility/Adaptability/Ease of Use exceed the guidelines. EADSlM has appropriate overall flexibility in all areas.
- Documentation met established guidelines. Manuals are comprehensive, well-written, and well-maintained. Development documentation is effective though not fully complete.
- User Support exceeded guidelines. The training program is mature and the Hotline is responsive and capably-staffed.
- User Environment met the guidelines. There are many desired features that show attention to user group inputs; however, input requirements are complex - potentially extensive.
- Quality Management met the established guidelines. Effective procedures are currently in place; however, the procedures have not existed from program inception and Quality Assurance failed to meet some guidelines.
- Software Development exceeded guidelines. Generally reliable and maintainable and developed with attention to good practices.

The ATB assessment VV&A Checklist produced the following observations:

- Unit Development Folders (UDFs) maintained in electronic form but the exact contents were not audited by the ATB assessment team.
- Unit testing is performed by TBE but plans, procedures, drivers, and results are not maintained.
- Integration testing lacks formal test documentation but Beta Testing was assessed as being excellent.

4.1.2.2 AFOTEC Survey Report (November 1994)

In 1993, HQ AFOTEC/SAN conducted an EADSlM (version 3.0 with limited coverage of version 4.0) Model Verification & Validation Survey and developed a "V&V Survey - Quality Assessment Report", report number ENTEK/ABQ-94-0127-TR, which was submitted to the Air Force Operational Test and Evaluation Center (AFOTEC) in Albuquerque, New Mexico. This report outlines the EADSlM development history and describes V&V activities performed on the model as of mid-1994. Model development history was accomplished by reviewing developer documentation and miscellaneous briefings available through AFOTEC.

The history of past V&V efforts by users was conducted using a questionnaire and follow up telephone conversations. The following excerpts summarize the past V&V findings:

> "...The underlying theme in discussion was that resources/or V&V were non-existent.
>
> Almost all V&V activities were performed out of necessity to complete a project when anomalous results happened; few agencies had any record of such activities..."
>
> "Categorizing documented activities by verification or validation at the time of this publication was not possible due to the classified nature of the studies..."

4.1.2.3 IDA JADO/JEZ Validation (January 1995)

The Institute for Defense Analysis (IDA) published a limited EADSIM validation in January 1995 [8] in support of the Joint Air Defense Operation/Joint Engagement Zone (JADO/JEZ) joint test. The purpose of the JADO/JEZ joint test was to evaluate the relative effectiveness of alternative air defense concepts. The current air defense concept consists of separate Fighter Engagement Zones (FEZs) and Missile Engagement Zones (MEZs). The JEZ concept allows both SAMs and fighters to engage targets in the same air space at the same time.

To evaluate these concepts, two series of field tests were conducted on the Nellis AFB range complex. The first, Field Test 1 (FT1), took place in April 1992, and the second, Field Test 2 (FT2), occurred in August 1993. If the agreement between field test results and EADSIM model predictions was acceptable, the model would be used to extrapolate the field test results to other scenarios including a Desert Storm-like scenario.

The IDA validation also included other activities in addition to the field test comparisons. In particular, a strong emphasis was placed on expert review ("face validation") and

sensitivity analyses. The sensitivity analyses examined 22 separate variables alone and in various combinations for both FEZ/MEZ and JEZ which resulted in a total of 152 sensitivity runs. The sensitivity analyses were useful in that they revealed several errors in the scenario database and in postprocessing algorithms.

Blue forces in the JADO/JEZ field test scenario played a defensive role. The blue force consisted of 8 air defense fighters (either eight F-15s or four F-14s and four F/A-18s) and a number of support aircraft such as E-3, E-2C, RC-135, EP-3, ES-3, S-3B, EA-6B, and KC-135A and -130s. Blue ground forces consisted of four Patriot fire units with a Patriot battalion Information and Coordination Center (ICC) plus Hawk fire units (two Army units in FT1 and two Army plus two Marine fire units in FT2). There were more than 30 aggressor aircraft including 12 F-16s, four A-6s, four AV-8Bs, eight F-111s, and two F-4Gs accompanied by an E-2C for command and control, and KC-135A and -130 tankers.

The configuration managed version of EADSIM at the start of the JADO/JEZ joint test was version 2.05; however, this version was determined to contain several significant limitations that required correction prior to use. The JADO/JEZ program office funded more than 40 modifications to EADSIM which can be grouped into three modeling areas.

- Target identification processes
- SAM and aircraft operations
- C3 processes

Target Identification. The JEZ concept requires a positive target identification prior to engagement with either SAMs or aircraft; therefore a critical modeling requirement was an accurate representation of target detection, correlation, and fusion by electronic support measure (ESM) sensors such as the Patriot Target Signature System (TSS). Modifications to address these limitations included the addition of bearing-only sensor data with statistical uncertainty and processes for comparing these reports to library values and correlating them with local radar tracks.

SAM and aircraft operations. The limitations with SAM and aircraft operations that were modified included no multiple simultaneous engagements, no SAM missile conservation tactics, and no A-pole, F-pole, or “beaming” maneuvers used in air-to-air combat.

C3 processes. The shortcomings identified in the C3 modeling included no allowance for a SAM fire unit to reestablish connectivity with a commander after a temporary link disruption and the repetitive reassignment attempts by a commander for a SAM fire unit that has indicated it cannot engage a target.

One feature of the JADO/JEZ field tests was that it involved only U.S. equipment rather than a mix of U.S. and foreign equipment. Because of this, most of the input data required by EADSIM could be developed from system manuals and representative operator capabilities. All of the data was reviewed by subject matter experts. For some of the prototype systems, such as the Patriot TSS, actual performance data measured in FT1 was used for calibration.

Aircraft flight paths in EADSIM are characterized by a series of waypoints. Between waypoints, aircraft can reactively maneuver in response to scenario events such as target

engagement. As a result of this, the model-generated flight paths did not agree precisely with those of the field tests.

Resource limitations in the JADO/JEZ joint test precluded the measurement and detailed comparisons of human decision-making or sensor, countermeasure, and weapons system performance. Only four, high-level MOEs were compared in the validation:

- Striker Attrition--the percentage of attacking bombers killed before releasing ordnance on their assigned targets.
- Blue Losses--the percentage of air defense assets (both SAM and aircraft) successfully engaged or killed by the enemy forces.
- Fratricide--the percentage of blue aircraft killed by either SAMs or blue aircraft.
- Simultaneous Launches--the percentage of blue engagements for which both a SAM and an air-to-air missile have been simultaneously (within 1 minute) launched at the same target.

The results of the comparisons concluded that:

> "EADSIM reproduced relative trends but not the actual differences between FEZ/MEZ and JEZ,"

and that:

> "The field test revealed problems with low-level transit routes, radar-to-radar correlations, reporting responsibility conflicts, track duality, and short track segments. Based on a review of its capabilities and structure, EADSIM does not include the level of detail needed to represent these problems--so it could not have predicted these key FT2 results."

It is important to emphasize that these conclusions apply only to the JADO/JEZ version of the model and not the SSDC configuration-managed version. Many (but not all) of the JADO/JEZ modifications plus other enhancements were subsequently incorporated into version 4.01.

4.1.2.4 TMD COEA Assessment (June 1995)

The Theater Missile Defense (TMD) Cost and Operational Effectiveness Analysis (COEA) assessment of EADSIM was conducted to prepare an accreditation recommendation for the use of EADSIM, Version 4.02 in Phase I of the TMD COEA. Dr. Steve Bravy of BMDO/AQM was the assessment leader. The interview portion (on-site at TBE) of this assessment was conducted during the week of June 12-16, 1995 by members of the COEA Modeling and Simulation Panel. The draft report was developed during the June and July of 1995. The TMD COEA assessment of EADSIM was very favorable and no "show-stopper" issues were identified for the TMD COEA Phase 1 use of EADSIM. EADSIM's positive features included:

The assessment summary statement noted that EADSIM was "Generally the most comprehensive, widely-used, and heavily scrutinized model in the BMDO community."

EADSIM can model all entities in the TMD COEA (data driven).
EADSIM can model two-sided warfare.
EADSIM uses rule-based BM/C4I decision algorithms.
EADSIM has a flexible radar model and does resource management.
The simulation is supported by an experienced and competent development team.
EADSIM provides good representation of aircraft.
EADSIM includes terrain effects.
Most platforms can either be scripted or have responsive behavior.
EADSIM includes a communications model (networks and loading effects).
All platforms can be destroyed.
All TMD tiers (including boost) are modeled in EADSIM.
EADSIM has good input/output flexibility and a good graphical user interface.

The TMD COEA assessed EADSIM in some detail relative to its ability to meet the TMD COEA analysis requirements. Issues were identified and ranked 1) L=LOW, 2) M=Medium, 3) H=High, and 4) SS=ShowStopper. There were no SS priority issues. The TMD COEA assessment identified the following high priority issues related to using EADSIM for COEA analysis:

EADSIM cannot read National Test Facility (NTF) high resolution threat tapes.

EADSIM uses Data Functional Descriptors (value range 0 to 99) to represent track quality.

Firing doctrine can not be modified on account of last shot or only shot opportunities.

EADSIM does not include interceptor hand-off to another ground-based weapon system.

EADSIM's earth model is non-rotating.

The TMD COEA has prepared a complete and thorough report documenting the EADSIM assessment process and the assessment results. Dr. Steve Bravy at BMDO should be consulted for access to the assessment report. (BMDO/AQM, Suite 1200, Crystal Square II, 1725 Jefferson Davis Highway, Arlington, VA 22202 (703) 604-0355)

4.1.3 Active and Planned V&V

Two planned V&V-related activities have been identified to date in addition to the ongoing SMART VV&A tasks. These efforts are focused on EADSIM Version 5.0.

- SSDC TPO funded IVV&A being performed by Systems Development Corporation - FY96 plans include software process assessments, development of validation scenarios, software quality assessments (including static analysis of Version 5.0 source code), survey of EADSIM user V&V activities, and collection of Version 5.0 software defect data.

- V&V assessments in support of Phase 2 of the TMD COEA. Specific V&V activities, EADSIM versions, and schedule have not yet been established.

4.1.4 Summary of V&V Status

While EADSIM has strong community acceptance with BMDO and approximately 300 registered user sites, the currently available reports are based on short duration expert opinion assessments and user surveys. No reports were identified that involved head-to-head comparisons with accredited models or validation based on test data. The best known and best documented EADSIM V&V efforts are the ATB and TMD COEA assessments, which provide a good starting point for acceptance within those communities, but do not meet the definitions of verification or validation found in JCS Pub 1.

4.2 USAGE HISTORY

4.2.1 Introduction

The Usage History Section is provided to convey to the prospective EADSIM user a sense of the community acceptance of this model and the results derived from its use. The information provided in this section gives a good indication of its range of applications and capabilities.

EADSIM has been used as a mission or system level simulation providing up to many-on-many theater level modeling of air, land, and sea warfare. It has been used to support wartime planning, training exercises, major studies, and to evaluate emerging architectures and systems. It explicitly models command, control, communications and intelligence as well as each player in the scenario. The largest documented scenario used 6500 players but the actual upper limit could be much larger depending on the size of the computer and turn-around time requirements. It has been used to translate system performance, architecture, and doctrine into force effectiveness. EADSIM has also been linked with other simulations via the Distributed Interactive Simulation (DIS) and Aggregate Level Simulation Protocol (ALSP) methodologies.

EADSIM is managed by the Testbed Product Office (TPO), in the Battle Integration Center (BIC), of the United States Army Space and Strategic Defense Command (SSDC). TPO is the executive agent for the Ballistic Missile Defense Organization (BMDO), which provides the baseline funding of EADSIM. EADSIM is completely owned by the government and no parts of the model are proprietary to its developer. It has been used by all U.S. services, Department of Defense (DoD), other U.S. government agencies, and a large number of contractors. It has also been used under a Memoranda of Agreement with the U.S. Army by the United Kingdom, Israel, Australia, Germany, and North Atlantic Treaty Organization (NATO) at the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Center. EADSIM has been used in support of the Theater Missile Defense (TMD) Advanced Warfare Experiment (AWE) as well as TMD Cost and Operational Effectiveness Analysis (COEA) studies. EADSIM was also used by the U.S. Air Force Studies and Analyses Agency (AFSAA) to analyze attrition, Suppression of Enemy Air Defense (SEAD) missions, and refueling operations during Desert Shield/Desert Storm. The TMD COEA has specifically recommended EADSIM accreditation for a number of TMD COEA Phase 1 analysis tasks including baseline scenario runs, anchoring runs, vignette runs, and point of departure runs. The BMDO assessment of EADSIM states “EADSIM is generally the most comprehensive, widely-used, and heavily-scrutinized model in the BMDO Community.”

EADSIM or its recent ancestors have been in use for ten years. The current baseline release (under formal configuration control and available to all EADSIM users) is Version 5.0. There are currently over 300 registered user sites, with 143 sites using Version 5.0. Many of the major users provide funding for user-specific enhancements as well as technical direction of these additions. User-specific enhancements can be incorporated into the subsequent baseline release if approved by the EADSIM Configuration Control Board (CCB).

4.2.2 Usage Overview

EADSIM is a workstation hosted, mission or system level simulation that has been used by combat planners, material developers, and operational commanders to assess the effectiveness of TMD and air defense systems against a broad spectrum of extended air defense threats. It provides a many-on-many theater-level simulation of air and missile warfare to support analysis of joint and combined force operations, and to augment exercises with realistic air defense training.

EADSIM has been used to model fixed and rotary wing aircraft, tactical ballistic missiles, and cruise missiles. It also models infrared and radar sensors, satellites, command and control structures, sensor and communications jammers, communications networks and devices, and fire support. This is provided in an environment that includes the effects of terrain and attrition on the outcome of the battle.

EADSIM provides a number of capabilities to interact with other models. EADSIM has been confederated with campaign-level models such as the Corps Battle Simulation (CBS) and Vector-in-Commander (VIC); with high fidelity models such as TAC BRAWLER; and with virtual simulators such as the TI Reconfigurable Simulator configured as a Bradley Stinger Fighting Vehicle (BSFV). In these confederations, EADSIM has provided a variety of functions, such as providing real-time computer generated forces, playing Tactical Ballistic Missile warfare, or commanding aircraft transferred to other simulations.

EADSIM uses two standard interface protocols to confederate, the Aggregate Level Simulation Protocol (ALSP) and the Distributed Interactive Simulation (DIS) protocol. These protocols are managed by the US Army STRICOM and are the standard interface protocols for CINC level exercises, Corps level exercises, and integrated (virtual/live/constructive) exercises. Because EADSIM can run in either simulation time or real time, it readily accommodates message passing, event passing, and control passing using these standard interfaces. EADSIM has been used to enhance both training and analysis using CBS and VIC by bringing realistic air defense capability to the virtual battlefield.

4.2.3 Usage History

EADSIM, formerly known as the Command, Control, Communications, and Intelligence Simulation (C3ISIM) and the TMD/C3ISIM in its earliest years, was a technology outgrowth of a computer based modeling program developed by Teledyne Brown Engineering for the Assistant Secretary of Defense for C3I in 1987. That model was used to analyze the relative combat effectiveness of F-15 fighter aircraft without Joint Tactical Information Distribution System (JTIDS) and those equipped with JTIDS.

In late 1987, the Joint Tactical Missile Defense (JTMD) Special Task Force (STF) required a model to conduct analysis of TMD architectures. Teledyne Brown Engineering developed what is currently called EADSIM to meet the JTMD STF needs. The JTMD STF evolved into the Joint Tactical Missile Defense Management Office (JTMDMO), a U.S. Army Missile Command organization.

Initial work on EADSIM was directed by a U.S. Government sponsored TMD Supervisory Working Group (SWG) composed of representatives from over twenty U.S. and foreign agencies, including representatives from all of the Military Departments, DoD, and NATO. From the beginning, the intention of the SWG was to ensure that the simulation was sufficiently flexible to support analysis work beyond the scope of the initial effort.

The Theater Missile Defense Applications Project Office (TMDAPO) of the U.S. Army Strategic Defense Command (USASDC), later to become USASSDC, joined JTMDMO in the development of EADSIM in 1988. TMDAPO and JTMDMO were later merged in a reorganization resulting in the formation of the Joint Theater Missile Defense Program Office (JTMDPO), USASDC. This organization formed the TPO to manage its testbed and simulation projects. Since that time, the TPO has maintained full development responsibility.

The use of EADSIM in Desert Shield/Desert Storm served as a springboard for EADSIM growth. EADSIM use expanded beyond the analytic community to the combat development and operational communities as well. EADSIM users nearly doubled in the year following Operations Desert Shield and Desert Storm.

The SWG grew into a group of EADSIM users that provided input and guidance to the program through participation in the program reviews and an executive committee for change approval. This led to the formation of the first formal CCB which met in 1993. Although somewhat ad hoc in 1993, the CCB matured with the approval of a formal Configuration Control Plan in 1994. The CCB, chaired by the TPO Manager, remains as a standing body with full configuration control authority over EADSIM. The participation of EADSIM users in program reviews has continued and has led to the formation of the EADSIM User's Group with additional regional meetings for users in the eastern and western regions of the US.

EADSIM has been selected as the primary simulation in the BMDO TMD COEA study, and as the primary Strategic Interdiction Operational Planning (SIOP) analysis model for the U.S. Strategic Command (STRATCOM) by the Modeling and Simulation Operations Branch.

4.2.4 Current Use and Users

EADSIM has been used by a broad spectrum of government agencies or its contractors throughout the United States and around the world. Table 4.2-1 contains some of the major government organizations that have or are currently using EADSIM. A complete listing of the entire EADSIM user base is contained in Appendix B. Many of the bigger government users provide funding as well as technical direction to make enhancements to the model. These changes must still be submitted to and approved by the CCB. Table 4.2-2 contains

some of the larger efforts which are currently being funded and some of the functional areas of EADSIM that are being enhanced or types of analysis performed using the model.

TABLE 4.2-1. Major Government Organizations using EADSIM.

Location	Government Organization
Huntsville, AL	• U.S. Army Missile Command • U.S. Army Space and Strategic Defense Command • Program Executive Office Missile Defense
Washington D.C.	• U.S. Army Concepts Analysis Agency • U.S. Air Force Studies and Analysis Agency • U.S. Naval Air Systems Command • BMDO - Ballistic Missile Defense Organization • Phase one Engineering Team (POET) • Center for Naval Analysis • Program Executive Officer Theater Air Defense • Office of Joint Chiefs of Staff (J-8)
Wright Patterson AFB, OH	• National Air Intelligence Center • Air Force Institute of Technology • Aeronautical Systems Center
Offutt AFB, NE	• U.S. Strategic Command
Colorado Springs, CO	• U.S. Space Command • National Test Facility
Fort Bliss, TX	• U.S. Army Air Defense Artillery School
Kelly AFB, TX	• USAF Information Warfare Center
Eglin AFB, FL	• Joint Air Defense Organization, Joint Engagement Zone Office
MacDill AFB, FL	• U.S. Central Command
Dahlgren, VA	• Naval Surface Warfare Center
Langley AFB, VA	• Air Combat Analysis Team
Hanscom AFB, MA	• USAF Electronic Systems Center
United Kingdom	• Defense Research Agency • Directorate of Science
The Hague, NL	• Shape Technical Center
Seoul, SK	• Combined Forces Command
Melbourne, AS	• Defense Science and Technology Organization
Adelaide, AS	• Defense Science and Technology Organization
Tel Aviv, IS	• Wales, Ltd.

EADSIM has been used to support several major studies and military exercises. In addition to the BMDO TMD COEA discussed in the next section, EADSIM has been used by the Navy in the Theater Missile Defense (TMD) COEA, by the Air Force in the Airborne Intercept COEA (sometimes called Boost Phase Intercept), in the Cruise Missile Defense Advanced Concepts Technology Demonstration (CMDACTD) Study headed by the Institute for Defense Analysis (IDA), and by the Army in the Theater High Altitude Air Defense (THAAD) COEA. Several major military exercises have been augmented by the use of EADSIM. These exercises are: Prairie Warrior (Army), Roving Sands (joint),

Green Flag (Air Force), Global 95 (Navy), Blue Flag (NATO), ULCHI Focus Lens (joint), and CJTFEX 96 (combined).

TABLE 4.2-2. Major User Organizations Providing Current Funding.

USAGE AREA/CUSTOMER	MODEL USE DETAILS	COMMENTS
BMDO-TMD COEA	Architecture Performance, Operational Effectiveness, Anchoring of Other Simulations	Meets all basic service requirements for COEA Phase 1. Upgrade will support EADSIM as primary tool for COEA Phase 2.
Air Force Studies & Analysis Agency	Attack Operations, C3I system trades, boost phase intercept, a/c routing, TMD COEA	Also used as Desert Storm planning/lessons learned tool - much success, long term user
PEO Missile Defense	PATRIOT, THAAD, CORPS SAM, GBR, Modeling Upper Tier/Lower Tier Coordination	Comparison with other models, Funding support for all system upgrades
Naval Surface Warfare Center	AEGIS Systems, SPY radar, C&C, CWI, Radar resource management, propagation	TMD and Navy COEA use, Relatively new / active user, Performed detailed testing of new mods
Air Force STRATCOM	Nuclear weapons damage, Penetration analysis and planning, Force allocation and deconfliction	Recently selected EADSIM as model of choice for several major uses after a year of evaluation
Air Force XOOC/Checkmate	Threat classification, Countermeasures, Sensor management, Attack operations, SAM reactions	Heavy user of EADSIM during Desert Storm, long term user and funder
Air Force Operational Test and Evaluation Center	Sensor EMCON management, Dynamic jamming	Also funding post-processor upgrades
Army Missile and Space Intelligence Center	Missile 3 DOF Flyout, Modeling mostly RED missions	Compared well with 6 DOF models, funded explicit flyout mods
Institute for Defense Analysis	Cruise Missile Defense, Advanced Concepts, Battle Management, JADO/JEZ	Funding major mods for Cruise Missile Defense. Some comparison with other models & field test
Air Force Space and Missile Command	Space-based infrared sensor, Information fusion, TMD COEA	Funding major modifications for satellite upgrades
Air Force Model and Simulation Center	COEAs, JSTARS, JTIDS, Interoperability trades, ISR, Enhanced detection and information processing	Long term user and funder, also use several other models with result comparisons and data transfer

4.2.6 EADSIM Use In BMDO TMD COEA

For the BMDO TMD COEA, the capabilities of EADSIM were matched with the modeling needs of the Force-on-Force Baseline Analysis for COEA Phase 1. Specifically, EADSIM was used for baseline scenario runs, anchoring runs to ancillary models used in the COEA,

vignette runs, and point of departure runs. These EADSIM COEA uses are discussed in the following paragraphs.

The purpose of the TMD COEA base line scenario runs was to examine the cost and operational effectiveness of alternative TMD architectures. Three fundamental questions needed to be answered: 1) what is the adequacy of the Baseline Architecture, 2) what are the Architecture Alternatives, and 3) what are the proper priorities within architecture alternatives. For the in-depth analyses, EADSIM was used to investigate the architectures in a combined arms context, and studies were conducted over many hours of a prescribed conflict.

These EADSIM scenario runs were used to validate the basic high level premises of the overall COEA analysis. In this task, all theater interactions were incorporated, at a top level, to yield an integrated picture of performance. EADSIM was used as a community accepted source of key system and architecture-level modeling for measures of effectiveness analysis. Accounting was made of threat attrition by type, inventory usage, system, site, communications throughput, sensor traffic handling, intercept timelines, and other measures of effectiveness. Some sensitivity studies were performed using EADSIM. It was also used to assess the impact of critical sensitivities at the force-on-force level.

The number of parameters contributing to the cost effectiveness of TMD architectures is very large, and the span of each is quite broad. Therefore, the parameter space for an in-depth analysis of alternative architectures required a scoping study to reduce the space to a tractable size. There was a total of 42 EADSIM runs for record. The complete run matrix for the TMD COEA analysis included these EADSIM cases plus those performed with the ancillary tools.

The TMD COEA study management required that EADSIM be used to "anchor" ancillary models used for analysis. To more fully examine the parameter space of the TMD COEA, ancillary models were used to investigate critical issues in more detail than may be obtained directly from EADSIM. However, these models were typically not "accredited" and are not community standards. Thus, they and their products could be viewed with skepticism, especially when they generate results contrary to conventional wisdom or program advocacy. To mitigate these concerns, the approach adopted for the TMD COEA required that these tools be used to generate results for some of the same cases being addressed by EADSIM.

"Anchoring" these tools to EADSIM established some confidence that the results they provide for a broader set of cases are valid. As an additional safeguard, when results from these other tools were particularly crucial to the architecture assessment, they were "spot-checked" with additional EADSIM runs. These tools were anchored to EADSIM by comparing relevant measures of effectiveness, such as the first and last shot opportunity times and the associated intercept positions. Pre-commit functions were anchored for some studies, and direct comparisons of radar and weapon performance between models were necessary in other studies.

EADSIM was also used for vignette runs. The duration of the scenarios studied were on the order of months. However, TBM raids often occur in the space of hours to a few days. Full cross-sectional analysis of these raids were required. EADSIM was used to perform one day vignettes on a subset selected from the total number of days within the scenario.

These key days were analyzed fully by EADSIM for all the MOEs that were relevant within a single vignette.

The fourth use of EADSIM was for point of departure runs. Multiple in-depth analyses were performed that used the EADSIM results as a starting point. These analyses went into greater detail than EADSIM and provided an overall confidence in the assumptions that had gone into the EADSIM studies. For example, end-game lethality was evaluated in detail by a 6-DOF simulation on a sample set of EADSIM engagements. Correlated leakage studies were performed to determine the impact on Pk for a second shot against a threat that was hit but not killed in the first shot engagement.

Wherever possible, EADSIM results from the run matrix were used for point of departure runs. Occasionally, however, in-depth studies required further EADSIM runs to more narrowly focus on one time span or aspect of a battle. These runs were vignettes or subsets of vignettes.

4.2.7 Summary

EADSIM has wide use in the air defense community and it has supported a number of large studies and exercises. EADSIM has a large user base and is supported by an established and stable development team. User support is strong and provides a majority of the funding for EADSIM enhancements and additions.

4.3 IMPLICATIONS FOR MODEL USE

The relatively large number of registered EADSIM users (approximately 300) is strong evidence of wide community acceptance in spite of the fact that relatively little formal V&V has been accomplished. Verification has been limited by the lack of detailed design specifications against which the implementation can be compared, and validation has been limited by the paucity of adequately-instrumented many-on-many field tests. Most of the assessments that have been reported are based upon “face validation;” however, one can be reasonably confident in the credibility of model results when the anticipated model application resembles one that has been previously used.